Space Weather Technical Forecast

Issued on Thursday, 15 February 2024 at 00:34 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight Chance G1 Minor Storms Day 1 (15 Feb) due to possible CME arrival. Isolated M-flares likely, and slight chance X-flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate activity in the last 24 hours with two M1.0 flares at 14/0310UTC and 14/0735UTC, from AR3582 and AR3576 respectively.

There are currently seven numbered and one un-numbered sunspot regions on the visible disc, with AR3576 persisting as the largest and most complex region as it transits toward the west limb. Some growth has been evident in the leading portion, although this has been balanced by some weakening of peripheral trailing spots. Two delta configurations remain within this region. AR3582 (Dai/Beta) and AR3583 (Eso/Beta) are the next largest regions. Slight decay has been observed in AR3582, which persists as a pair of closely located bi-poles. AR3583 has seen a reduction in its small intermediate spots, with the region spreading into a more open configuration. Newly numbered region AR3586 is turning onto the far northeast of the disc, for now assessed as a moderate size Hsx/Alpha. Remaining spot region are small and magnetically simple.

No Earth-directed CMEs were observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds as recorded by DSCOVR/ACE were between background to slight-elevated levels, 350-500km/s, but generally near 450 km/s. Density was at or near below average levels. Interplanetary magnetic field (IMF) Bt, was at weak levels, 4-7nT, but became moderate around 9nT at 14/2218 UTC. The north-south directed field, Bz, varying weakly between -5 and 7nT. Phi angle was positive (away from the Sun) until around 14/1730 UTC, then switched to negative (toward the Sun). Geomagnetic activity was mostly Quiet (Kp 0 to 1), but was Unsettled (Kp 3) 14/0000-0600 UTC.

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux was above the S1 Minor Radiation Storm through much of the period, with a peak of 47 pfu at 14/1030 UTC. Flux levels then slowly declined, falling consistently below the S1 threshold after 14/2000 UTC. GOES16 high energy (greater than 2MeV) electron flux remained at background. The associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold. The observed fluence at 15/0000UTC was 1.32e6 pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected with the likelihood of further isolated M-flares, and a slight chance of X-flares. These most likely from AR3576 in the southwest.

Solar Wind / Geomagnetic Activity: There is one CME still thought to have the potential to influence the near Earth environment, this associated with the M9 flare on 10 Feb. This was originally expected on 13 Feb, but its delayed arrival may be being observed as a weak

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enhancement in solar wind parameters at 14/2218 UTC.

Solar winds are currently slightly elevated with any further weak CME influence not anticipated to significantly increase winds during day 1 (15 Feb). There are also no significant coronal hole enhancements expected, with coronal hole 97 likely too far south, and small coronal hole 99 likely too far north to influence solar winds at Earth.

A slight chance of Active to G1 Minor Storms is maintained for day 1 (15 Feb) given some likely weak CME influence at first. Otherwise, mainly Quiet activity is expected, with a chance of isolated Unsettled intervals.

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux is now just below the S1 Minor Radiation Storm, and on a slowly declining trend. Proton flux is expected to continue slowly declining through the period in the absence of further significant flare activity. However, there does remain an ongoing chance of further enhancements, most likely from AR3576, given any significant flares,

High energy electron flux (greater than 2MeV) is expected to be at mainly background but with a chance of rising to Moderate if any stronger CME influence is observed on day 1 (15 Feb). The associated 24-hour electron fluence is expected to stay below the active threshold, but perhaps with a rising trend later in the period.

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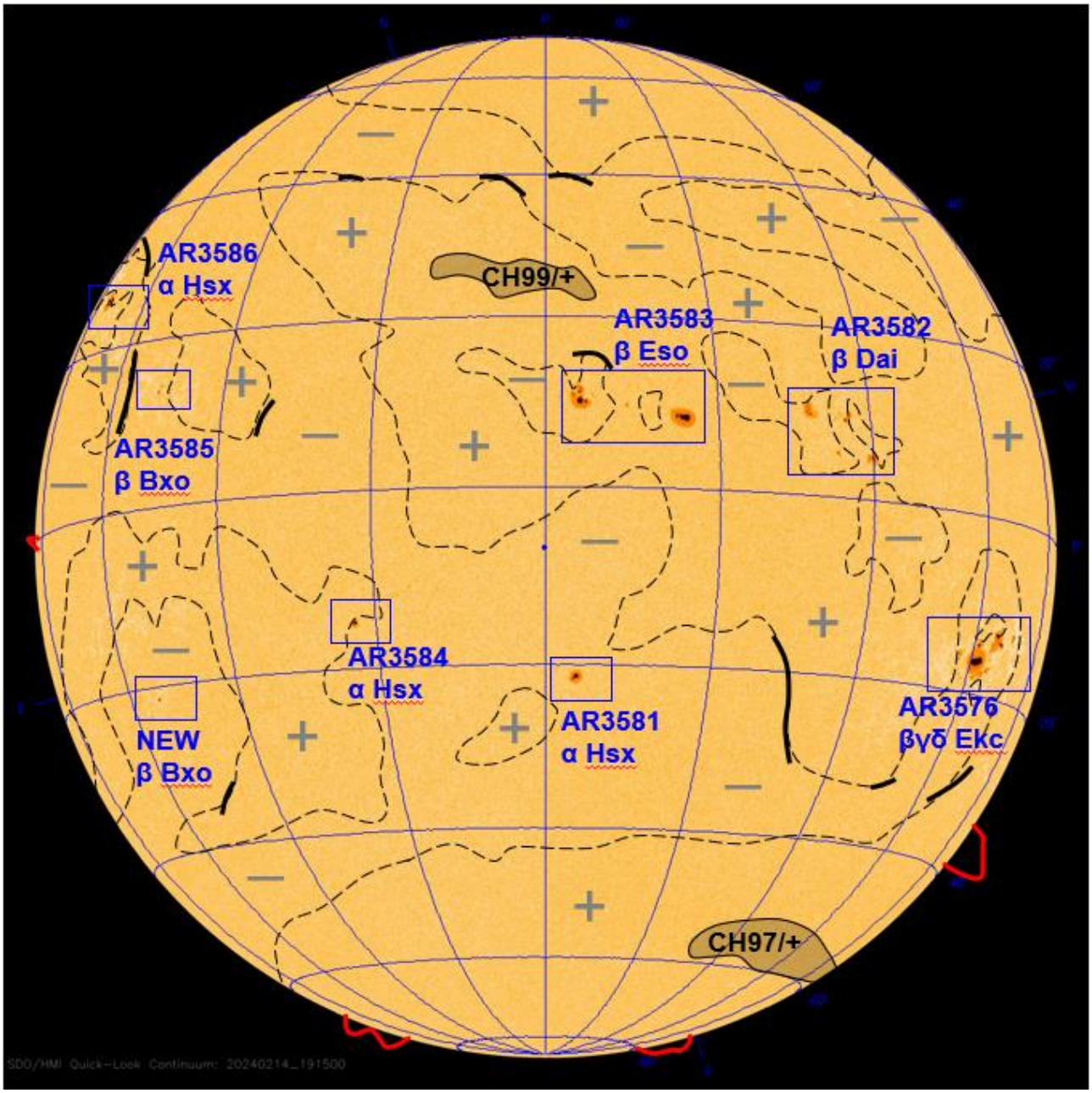
Figure 1. Solar Analysis Valid 14/1930 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There is one CME still thought to have the potential to influence the near Earth environment, this from the M9 flare associated with AR3576 on 10 Feb. This was originally expected on 13 Feb, but its delayed arrival may be being observed as a weak enhancement in solar wind parameters at 14/2218 UTC.

Solar winds are currently slightly elevated with any further weak CME influence not anticipated to significantly increase winds during day 1 (15 Feb). There are also no significant coronal hole enhancements expected, with coronal hole 97 likely too far south, and small coronal hole 99 likely too far north to influence solar winds at Earth.

A slight chance of Active to G1 Minor Storms is maintained for day 1 (15 Feb) given some likely weak CME influence at first. Otherwise, mainly Quiet activity is expected, with a chance of isolated Unsettled intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
11/0330	Partial halo shock. Material to NE	M9 from AR3576 plus subsequent filament lift off	S centre, deflected NE	810 km/s	Early 14 Feb	Weak enhancement 14/2218 UTC could be CME glance.

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Met Office Space Weather Technical Forecast

Radio Blackouts - X-Ray Flares:

Low to Moderate activity is expected with the ongoing likelihood of isolated M-flares, and a slight chance of X-class flares. These most likely from AR3576 in the near term with the persistence of a delta spot configuration within the region maintaining the complexity and consequently the potential for significant flares. This region rotates over the west limb by day 3, however the flare risk from this region will likely continue until the end of the period. AR3582 and AR3583 in the northwest quadrant are also moderately sized bi-polar regions, however these have a simpler magnetic configuration, and a horizontally aligned field, giving a lower potential for notable flares. Both these regions remain relatively stable with some slight decay now evident.

Also of interest is a new region AR3586 moving onto the northeast disc. This region may have been the source of a M2.6 flare from over the limb on 12 Feb, and could reveal further complexity in the days.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	70	70	60	50
Very Active	R3 to R5 X Class	No	15	15	10	10

Solar Radiation Storms - (High Energy Protons):

GOES 18 high energy (greater than 10MeV) protons remained enhanced above the S1 threshold for much of the period, following a large far-sided flare on 13 Feb, most likely originating from ex-AR3575 rotating towards the centre of the far-side disc. The observed peak was 47 pfu at 14/1030 UTC. Flux levels then slowly declined, falling consistently below the S1 threshold after 14/2000 UTC.

Proton flux is expected to continue slowly declining through the period in the absence of further significant flare activity. However, there does remain an ongoing chance of further enhancements, most likely from AR3576, given any significant flares, This is due its location in the western disc, which is favourable for any protons to be directed towards Earth. Later in the period this risk should diminish as it rotates beyond the west limb.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	Yes	40	30	20	10
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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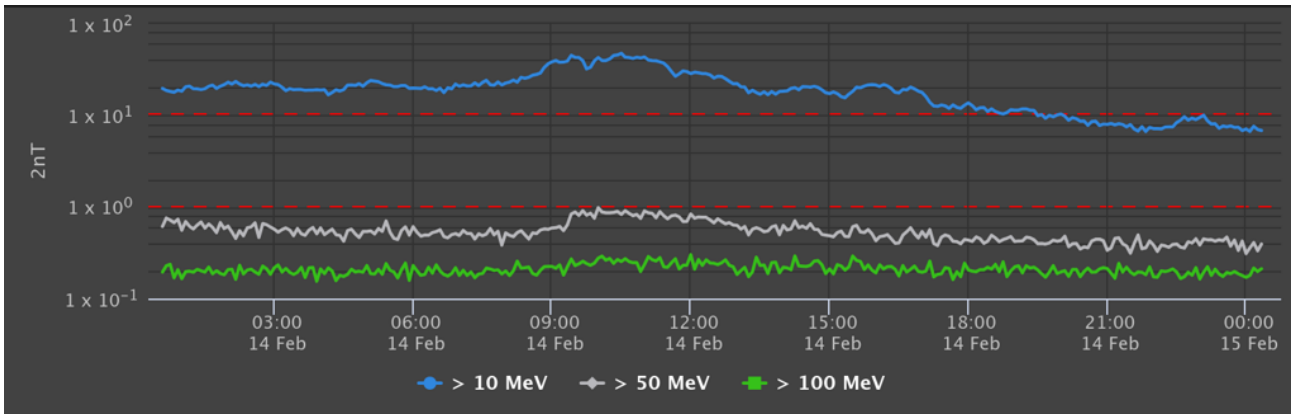
Figure 2: GOES-18 Proton flux.



High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) as observed by GOES-16 is forecast to persist at background, although this may depend somewhat on the strength of any potential enhancement from any further transient CME activity on day 1 (15 Feb). Any stronger effects could populate the Van Allen Belts, but also initially compressing them inside of GEO. As any enhancement eases, and these expand outwards again, flux could rise to Moderate with a very slight chance of peaking briefly at High from day 1 onward (15 Feb)

The associated 24 hour electron flux is expected to remain well below the Active (1e8 integrated pfu) threshold, but may see an increasing trend later in the period. REFM is thought to be giving generally good guidance in the absence of any significant further CME arrivals.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	1	5
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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